Draft Plan of Actions to Restore Salmon and Steelhead Populations in the Lower Calaveras River

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Prepared for
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Summary

This Draft Restoration Plan for the lower Calaveras River includes actions that would improve populations of salmon and steelhead in the Calaveras River. Fall-run and winter/spring-run Chinook salmon and steelhead trout can be restored in the Calaveras River if existing limiting factors are alleviated. Populations are limited under present conditions by passage problems and low streamflow at critical times of the year. Actions are prescribed at five levels of priorities to restore salmon and steelhead. Priority 1 actions consist of improving adult salmon and steelhead passage at the Bellota Weir and other barriers on Mormon Slough and the Old Calaveras River Channel, and providing 20 cfs of flow between Bellota and tidewater during November and for a one-month period during the winter. Priority 2 actions would improve downstream passage of young salmonids by increasing fall, winter, and spring flows in dry years between Bellota and tidewater. Priority 3 actions are to restore spawning and rearing habitat through improved streamflow below New Hogan Dam during the non-irrigation season, reduced populations of non-native and native predatory fishes, improved stream channel habitat, screening water diversions, and removing structures that alter habitat and hinder passage. Priority 4 is to restore winter-spring run Chinook salmon. Priority 5 actions are to sustain salmon and steelhead populations through extended droughts with trap and haul of adult and juvenile salmon and steelhead, and artificial propagation.

Introduction

The purpose of this restoration plan is to identify actions necessary to restore Chinook salmon and steelhead populations of the Calaveras River, a tributary of the San Joaquin River near Stockton, California (Figure 1). At present both populations are limited, and viable populations may not exist. Historic populations of winter-run and fall-run Chinook salmon and possibly steelhead could be restored to the river system. The major limiting factors are low streamflow and passage barriers.

This study plan was developed with guidance from the California Department of Fish and Game's Restoring Central Valley Streams – A Plan for Action (DFG 1993), CALFED Strategic Plan and Ecosystem Restoration Program Plan (CALFED 2000), and the Central Valley Project Improvement Act Anadromous Fish Restoration Program of the US Fish and Wildlife Service (AFRP 2001). Further guidance was obtained from planning efforts of the Calaveras River Technical Advisory Committee (Technical Committee) with participants from the National Marine Fisheries Service (NMFS), AFRP, California Department of Water Resources Fish Passage Program (DWR-FPP), California Department of Fish and Game (DFG), Calaveras County Water District (CCWD), Stockton East Water District (SEWD), S.P. Cramer & Associates, Stillwater Inc., the Fishery Foundation of California (FFC), and various public stakeholder groups.

Figure 1. Calaveras River

This plan focuses on means for improving passage and habitat of Chinook salmon and steelhead trout. Adult salmonid upstream passage problems include blockage at structural barriers and adequacy of stream flows for upstream adult migration and downstream juvenile emigration.

Juvenile salmonid downstream passage problems include structural barriers, lack of streamflow, and unscreened water diversions. Habitat concerns include (1) instream flows for spawning and rearing, (2) adequacy of gravel spawning habitat, (3) adequacy of cool water rearing habitat, and (4) competition and predation by non-native warm-water fishes.

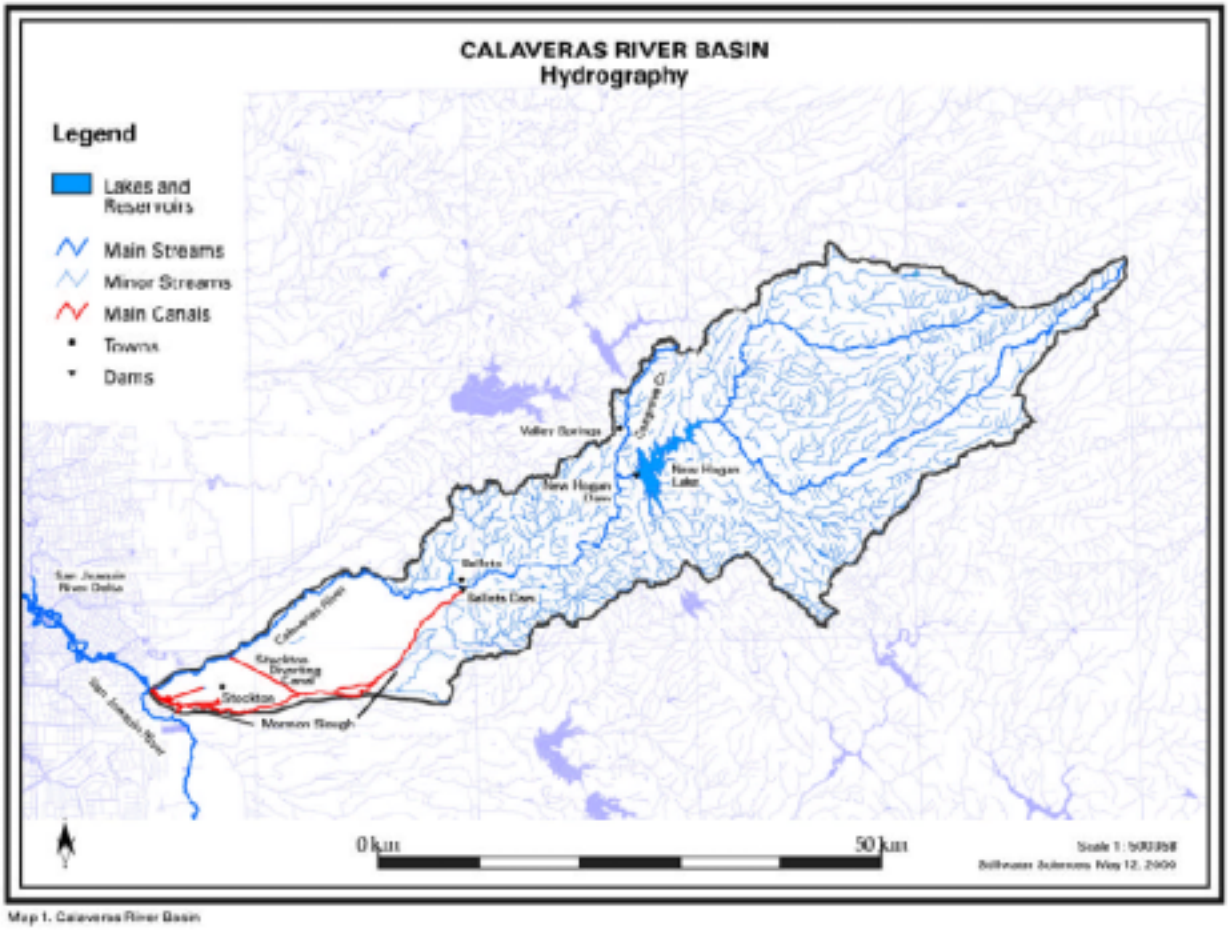

Figure 2. Calaveras River watershed. (Source: Stillwater Sciences 2000)

Background

The Calaveras River is a relatively small Sierra watershed between the Mokelumne and Stanislaus Rivers (Figure 2) within the San Joaquin River system in Calaveras, Stanislaus, and San Joaquin Counties. The Calaveras River watershed is approximately 600 square miles with an average historic unimpaired runoff of 150,000 acre-feet per year and a minimum of about 12,000 acre-feet per year. The North Fork begins at Pine Ridge at an elevation of about 4,000 feet. The headwaters of the South Fork, San Antonio Creek, begins at Summit Level Ridge at an elevation of 6,000 feet.

Streamflow in the lower watershed is controlled by releases from New Hogan Lake, a 317,000 acre-foot US Army Corps of Engineers (USACE) flood control and water supply reservoir formed by New Hogan Dam built in 1964 located 38 miles upstream from the mouth of the river.

The USACE maintains storage below 152,000 acre-feet from December to May for flood control. Storage water rights are held by CCWD and SEWD through the US Bureau of Reclamation.

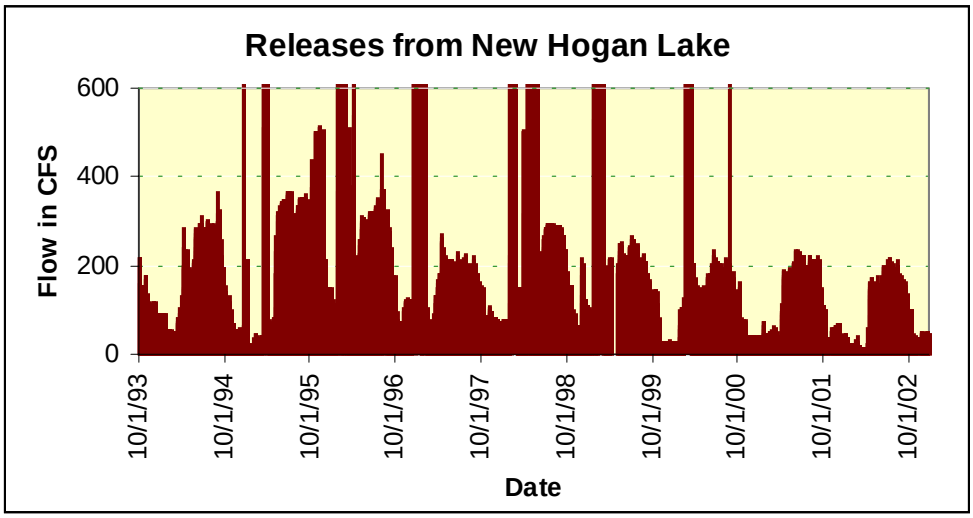

Figure 3. Water releases from New Hogan Lake in water years 1993-2002. Controlled releases for flood control were made in fall of 1995 and 1998. Uncontrolled releases during the winter occurred in each winter of water years 1995 through 2000. Water generally does not reach tidewater except during these two release types or for short periods during local rainfall events.

Releases from the reservoir provide year-round flows downstream to Bellota. Releases from the spring through early fall irrigation season generally range from 150 to 250 cfs (Figure 3). Non-irrigation season releases in non-drought years range from 20 to 50 cfs to meet downstream municipal water supply demands. In drought years, non-irrigation season releases are less. Water diversions from New Hogan Dam downstream to Bellota, including those of CCWD and SEWD, remove most of the river flow, except during the rainy season. A small amount of water is released into the Old River channel and Mormon Slough at Bellota during the irrigation season for downstream users including groundwater recharge; however, the lower channels near Stockton are usually dry except during the rainy season. The two main water diversions are the CCWD diversion just below New Hogan Dam, which diverts water via a Rainy Well system, and the SEWD Bellota Intake diversion that feeds the Dr. Joe Waidhofer Water Treatment Plant via the Bellota Pipeline[1]. In addition there are 29 operating agricultural water diversions between New Hogan Dam and Bellota Weir, and several more in each channel below the Bellota Weir.

[1] SEWD receives the surface water it supplies to the Stockton area from two separate sources. The first source of surface water comes from the Calaveras River system, which includes the New Hogan Reservoir. Water from this source is diverted into a pipeline from the river at Bellota and brought to SEWD's water treatment plant located at East Main Street in Stockton. The second source of surface water comes from the Stanislaus River system's New Melones Reservoir. Water from this source is diverted from the Stanislaus River at Goodwin Dam and brought to SEWD's water treatment plant through the Goodwin Tunnel and upper and lower Farmington canals. The use of surface water from SEWD has enabled the City to reduce its dependence on groundwater to meet the needs of its customers. Eastern San Joaquin County has a problem with declining groundwater levels, and use of surface water has generally improved the groundwater levels under the City's water service areas.

Most of the water entering the lower Calaveras system at Bellota is diverted to Mormon Slough for irrigation and flood control purposes. Only during flood flows does water pass over the weir into the Old Calaveras River channel. Some water is diverted into the Old River channel through gated culverts during the irrigation season. Near Stockton, Mormon Slough flows are diverted to the Stockton Diverting Canal back to the Old Calaveras River channel, where water flows downs to the San Joaquin River (see Figure 2). Below the Bellota Weir the Calaveras River system has been reconfigured as a flood control and storm drainage system with Mormon Slough and the Diverting Canal being the principle water conveyance channels. During the dry season, both Mormon Slough and the Old River Channel serve as conveyance for local irrigation supplies.

The river above Bellota Weir upstream to New Hogan Dam is a natural stream channel confined in most places by a foothill canyon. The lower section of the river immediately above Bellota has a lower gradient and its floodplain has been altered for agriculture. The channels below Bellota are essential ditches designed to carry irrigation water during the irrigation season and flood flows in winter and spring.

Chinook salmon and steelhead occur in small numbers in the lower Calaveras River. Historically, the Calaveras River had a small run of winter-run Chinook salmon after New Hogan Dam was built, which migrated up the river during winter rains and spawned in the summer below New Hogan Dam. During the drought of 1987-1992 all salmonids were probably eliminated from the river below New Hogan Dam, as the fish population reverted to warm-water species (USFWS 1993). Since the drought of the late 1980's and early 1990's only fall-run Chinook salmon have sporadically been observed ascending the river with late fall rains. Small numbers of steelhead trout have been observed in the river over the years. In 2000, the lower Calaveras River was designated as critical habitat of steelhead by the NMFS. In the spring of 2002 several pairs of steelhead spawned in the channel downstream of the Bellota Weir. Whether the salmon or steelhead are strays from other rivers or born in the Calaveras River is not known. A healthy resident population of wild self-sustaining rainbow trout lives between New Hogan Dam and the Bellota Weir, and may contribute some smolts that migrate to the ocean and return as steelhead. The origin of these trout is unknown.

Surveys conducted by Stillwater Sciences and the Fishery Foundation indicate that in the reach below New Hogan Dam there is limited area suitable for Chinook salmon spawning. Survival-to-emergence from redds constructed in these areas is likely low from lack of flows sufficient to mobilize the channel bed and flush out fine sediments and sand from spawning pools and riffles. Stillwater Science and the Fishery Foundation are presently conducting studies (2001-2003) under a CALFED grant program entitled the "Lower Calaveras River Chinook Salmon and Steelhead Life History Limiting Factor Analysis". The ultimate goal of this project is to help provide the scientific basis for real-time management of the Lower Calaveras River to optimize conditions for water supply, flood control, power production and natural production of anadromous fish. The principal goals of the first-year effort were to (1) initiate a quantitative evaluation of salmonid habitat, population density, distribution and life history and (2) facilitate stakeholder involvement in anadromous fish habitat restoration.

The AFRP and CALFED Bay-Delta Program have been working together to plan and implement restoration of the Calaveras River. A list of recommended AFRP actions developed in 1995 is

presented below in Table 1. CALFED recommendations and visions for the Calaveras are presented in Tables 2 and 3.

The SEWD is presently undertaking informal ESA Section 10 permit consultation for their operations on the Calaveras River. A NMFS Section 10 permit would allow a small amount of take of federally listed steelhead with some protective and mitigation measures to protect the threatened steelhead.

Table 1. AFRP Actions. (Source AFRP)	Involved parties	Tools	Priority
1. Supplement flows with water acquired from willing sellers consistent with applicable guidelines or negotiate agreements to improve conditions for all life history stages of chinook salmon.	Calaveras County Water District, Stockton East Water District (SEWD), CDFG, COE, USFWS, USBR	3406(b)(3)	High
2. Provide flows of suitable water temperatures for all salmonid life stages.	CDFG, USFWS, USBR	3406(b)(3)	High
3. Facilitate passage of adult and juvenile salmonids at existing diversion dams and barriers.	Diverters, CDFG		Medium
4. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, CDFG, CDWR, USFWS, NMFS, USBR	3406(b)(21)	Medium

Evaluation Actions	Involved parties	Tools	Priority
1. Monitor sport fishing and evaluate the need for regulations to protect salmonids.	CDFG		Low
2. Evaluate instream flow, water temperature and fish habitat use in the Calaveras River to develop a real-time management program so that reservoir operations can maintain suitable habitat when fish are present.	CDFG, Diverters, USFWS		High

Table 2. CALFED Recommendations. (Source CALFED 2000)
Focus: For the Calaveras River, the emphasis will be on providing the opportunity for fall-run Chinook salmon to spawn successfully and providing juveniles the opportunity to emigrate from the system successfully.
Vision: The vision for the Calaveras River Ecological Unit is to restore and maintain important ecological processes that support a sustainable migration corridor for fall-run Chinook salmon and other fishes.
• The vision for the Calaveras River includes improvements in streamflow, gravel recruitment, floodplain configuration, fish passage, riparian and stream channel habitat, screening of diversions, and enforcement of fishing regulations.
• Restoring instream flows adequate to maintain anadromous fish habitat will be the focus element. Maintaining an adequate water temperature regime, improving fish passage at irrigation dams, and reducing entrainment at water diversions will also be important.
Streamflow: Instream flows are inadequate and need to be supplemented where possible, consistent with existing agreements. Increased flows would help restore ecological processes and functions that maintain habitats for important aquatic and terrestrial species. The vision is that instream flows will be at levels and mimic natural flow regimes that support restored ecological processes and function that maintain important fish, wildlife, and plant communities and their habitats.
Coarse Sediment Supply: The input of sediments into the riverine systems below major dams is inadequate to maintain ecological health. The vision is that gravel recruitment, transport, and cleansing processes will be restored, reactivated, or supplemented to a level that supports habitat for anadromous and other native fish populations and sustains self-regenerating riparian and riverine plant communities.
Natural River Floodplain and Flood Processes: The interaction been rivers and their floodplains has been impaired by the construction of dams and levees. Seasonal inundation is needed to promote ecological health and restoration of important species. The vision is that floodplains along the Calaveras River will be expanded, reconnected to their channels, and seasonally inundated by increased stream flows. These actions will support natural riparian regeneration and nutrient input to the Delta and help create seasonal habitat for splittail spawning and the rearing and emigration of juvenile fish.
Central Valley Stream Temperatures: High stream temperatures limit or interrupt the natural life cycle of aquatic organisms. The vision is that water temperatures below major dams will be suitable for maintaining important aquatic organisms and biological functions, such as Chinook salmon and steelhead spawning, egg development, and fry and juvenile rearing and emigration.
Riparian And Riverine Aquatic Habitats: Riparian plant communities are important to a healthy ecosystem and contribute in many ways to sustaining fish and wildlife populations. The vision is to restore diverse, self-sustaining riparian and shaded riverine aquatic habitat along the lower reaches of the Calaveras River.

Table 3. CALFED visions for the Calaveras River. (Source CALFED 2000)
Streamflow and Floodplain Processes: Freshwater fish habitat is an important component needed to ensure the sustainability of resident native and anadromous fish species. The streams of the Eastside Delta Tributaries Ecological Management Zone are typical of a fall chinook salmon-spawning stream (Moyle and Ellison 1991). The quality of freshwater fish habitat in these streams will be maintained through actions directed at streamflows, coarse sediment supply, stream meander, natural floodplain and flood processes, and maintaining and restoring riparian and riverine aquatic habitats.
Essential Fish Habitat: The Mokelumne, Cosumnes, and Calaveras rivers have been identified as Essential Fish Habitat (EFH) based on the definition of waters currently or historically accessible to salmon (National Marine Fisheries Service 1998). Key features of EFH to maintain or restore in these streams include substrate composition; water quality; water quantity, depth and velocity; channel gradient and stability; food; cover and habitat complexity; space; access and passage; and flood plain and habitat connectivity.
Water Diversions: The vision is to contribute, to adult fish survival and return by reducing the loss of juvenile aquatic organisms into water diversions and lessen the impact of water diversion on the elevation of the water table.
Dams And Other Structures: The vision is to contribute to restoring chinook salmon and steelhead by improving up- and downstream fish passage at diversion structures.
Predation And Competition: The vision is to contribute to restoring naturally spawning chinook salmon and steelhead populations by modifying hatchery practices and instream structures to reduce rates at which juvenile salmonids fall prey to predators.
Splittail: The vision for splittail is to recover this federally listed threatened species. The vision is to contribute to splittail restoration by improving the riparian and stream meander corridors and natural floodplains along the Cosumnes and Mokelumne Rivers. The value of the seasonal habitat will be improved by late-winter and early-spring streamflows to provide attraction flows for spawning adults and increased spawning habitat.
Chinook Salmon: The vision for chinook salmon is to recover all stocks presently listed or proposed for listing under ESA or CESA, achieve naturally spawning population levels that support and maintain ocean commercial and ocean and inland recreational fisheries, and that use fully existing and restored habitats. The vision is to assist in fall-run chinook salmon restoration by: improving stream flows for passage, spawning, rearing, and emigration, improving gravel recruitment, providing water temperatures needed for successful egg incubation and rearing, increasing riparian and riverine aquatic habitat, reducing or eliminating unscreened diversions and sources of contaminants.
Steelhead Trout: The vision for steelhead trout is to recover this species listed as threatened under ESA and achieve naturally spawning populations of sufficient size to support inland recreational fishing and that use fully existing and restored habitats. The vision is to assist in steelhead trout restoration by: improving stream flows for passage, spawning, rearing and emigration, improving gravel recruitment, providing water temperatures needed for successful egg incubation and rearing, increasing riparian and riverine aquatic habitat, reducing or eliminating unscreened diversions, and sources of contaminants.
Native Resident Fish Species: The vision for resident fish species, including hitch and hardhead, is to increase their abundance and distribution by implementing actions to improve stream channel, floodplain, and riparian processes.

RESEARCH QUESTIONS AND PRESENT STATUS:

- ***Are there runs of Calaveras Chinook salmon and steelhead?*** *Are these genetically unique runs? Are the salmon and steelhead running up the Calaveras strays or hatchery fish? Are the "steelhead" simply large resident trout?*

  Surveys on the Calaveras River over the past several years indicate that small numbers of Chinook salmon and steelhead continue to run up the river with the first fall rains and during the winter. Although no salmon observed in live collections or carcass count surveys have been adipose clipped hatchery fish, too few have been collected to discount the possibility that many are hatchery strays given the low percentage of salmon clipped and code wire tagged at Central Valley hatcheries. Carcasses of several steelhead collected below Bellota Weir were too deteriorated to determine if the adipose fins were clipped. (All hatchery steelhead are adipose fin clipped.)

  Sportfishermen have long claimed that steelhead ascend the Calaveras River in the winter. The two adjacent photos are of large trout caught in the Calaveras River. It could not be determined whether these fish were adipose clipped and thus of hatchery origin. The lower photo is from a group of fish caught in February of 2000 during releases of about 100 cfs from New Hogan Dam.

  Surveys being conducted during the winter of 2003 will specifically look for steelhead in the lower Calaveras River. The study plan includes placing a weir in the lower river near tidewater to capture adult steelhead migrating into the lower river. Collections and observations will also be made at other weirs including the Bellota Weir fish ladder.

Calaveras River - Possibly one of the best-kept fly-fishing secrets in California, this small tailwater fishery flowing out of the New Hogan Dam provides excellent trout fishing year round. The wild Rainbows thrive in the cold water and Pacific Adventures has access to some great private water. There's not a bad month to fish this wonderful piece of water and we have landed trout up to five pounds. (Pacific Adventures web page)

Stockton Record photo of Calaveras River steelhead captured below New Hogan Dam, March 5, 2000 article.

- ***Are there low-water salmonid barriers?*** There are many barriers to salmonid passage in the lower Calaveras River channels including several each in the Old Calaveras channel, the Diversion Canal, and Mormon Slough. Weirs at Bellota including one at the head of Mormon Slough (Figure 4) and one at the head of the Old River Channel (Figure 5) are virtually impassable at many flows. At Bellota Weir, temporary ladders appear to be partially passable at flows below about 100 cfs. Various configurations of the temporary ladders have been tried. The most recent (Figure 4) includes flashboards placed on the lower terrace of the weir to deflect water to the weir and adjacent to it. This configuration has reasonably good attraction flow near the lower ladder exit and appears to work reasonably well at flows under 100 cfs, but is not effective at higher flows that attract salmon and steelhead to ascend the river. As flows fall to 20 cfs, sandbags are added to the lower terrace to force more flow through the ladder.

Figure 4. Temporary fish ladders are placed at Bellota Weir at the head of Mormon Slough each fall to provide salmonid passage over the weir. These temporary ladders have proven ineffective under most conditions.

Figure 5. Gated weir at Bellota at the head of the Old Calaveras River channel. Water is diverted into the Old Channel only to meet downstream irrigation demands. There are no screens and no fish ladder at this weir and it is virtually impassable to upstream migrating salmonids except during flood flows.

  Below Bellota there are several small weirs in each channel that have flashboards placed during the irrigation season to pool water for pump diversions or groundwater recharge. During the non-irrigation season (October-March) the boards are taken out; however, the base structures of these weirs can be impassable at lower flows typical of drier years. There are also several culvert crossings that hinder or pose a barrier to passage. The DWR-FPP is conducting a detailed evaluation of each of these barriers with the ultimate goal of designing engineering solutions to each barrier. So far they have identified 10 low flow road crossings, 3 bridge aprons, 24 culverts, 25 flashboard dams, and 2 in-river gravel pits in the lower Calaveras River that are potential barriers to salmonid migration.

The greatest barrier to fall-run Chinook salmon is the lack of water in the fall. Typically flows in the lower river from September through early December are near zero down to tidewater near Stockton. Few if any fall-run salmon can ascend the river in most years. New Hogan Reservoir captures most of the rainfall into the watershed. Local runoff in the lower river below New Hogan seeps quickly into the groundwater table. Sporadic October-November runoff provides some small outflow events of several days that attract small numbers of salmon from tidewater into the lower river. Most of these fish become trapped in the Diversion Canal or Mormon Slough, but small numbers sometimes make it to Bellota and spawn in gravel riffles below Bellota Weir.

Winter-run Chinook salmon and steelhead are also blocked from entering the lower Calaveras in winters and early springs of drier years by lack of flow. In the past eight water years, 1994, 2001, and 2002 had low winter flows that provided little winter attraction to the river (see Figure 3). Again, local runoff events in winter 2002 attracted small numbers of steelhead into the lower river, where they ascended and spawned in riffles below the Bellota Weir.

Figure 6. Old Calaveras River Channel downstream of Bellota in early October soon after irrigation diversions into the Old Channel ended. Small numbers of juvenile and adult trout and other fishes were trapped as the watered channel dried up in pools above flash-board weirs. This channel generally remains dry for most of the fall and winter, except in flood years.

Several large trout found stranded in the Old River Channel below Bellota in fall 2002 may have been steelhead that ascended into the Old River Channel during winter 2002 rainfall events. Water in the Old Channel dries up after the irrigation season stranding fish that previously ascended from downstream or descended from upstream (Figure 6).

- ***Is there adequate spawning and rearing habitat for salmon and steelhead between Bellota Weir and New Hogan Dam?***
  Spawning gravels occur in the lower Calaveras River in the first mile of river below New Hogan Dam and further downstream in the canyon and Jenny Lind reaches. In addition there are small areas of gravel riffles in Mormon Slough below Bellota Weir. Spawning gravels in the first mile below New Hogan Dam suffer from low permeability, but are adequate for several hundred pairs of salmon (Figure 7). Spawning gravels are similar in the middle reach between New Hogan Dam and the Bellota Weir. Below Bellota Weir the spawning gravels are limited and have poor permeability, but have produced some fry salmon in recent years. Several steelhead redds in this area in the spring of 2002 were likely unsuccessful as water temperatures reached lethal levels for trout eggs in the redds during the spring. Surveys of Cosgrove Creek, a small low-elevation tributary that enters the Calaveras River below New

Hogan Dam, indicate little gravel spawning habitat available because of a high gradient and bedrock substrate. Cosgrove Creek is probably an important contributor to what appears to be a limited supply of gravel to the lower river below New Hogan Dam. Present studies by Stillwater Sciences and the Fishery Foundation are evaluating the extent of spawning habitat and use by salmon and steelhead in the lower Calaveras River.

Rearing habitat in the approximately 15 miles of river between Bellota Weir and New Hogan Dam is generally good based on snorkel survey observations. Habitat is degraded in the lower reach above Bellota from instream gravel mining and channel alterations. Large pools with sandy substrate dominate the area. Some large gravel mining ponds within and adjacent to the river in this reach may be predator sanctuaries with pikeminnow being the predominant predator present. Cosgrove Creek is too warm in summer for salmonid rearing and has many warm-water fish including centrarchids that may prey on young salmonids and contribute to these non-native fish moving downstream and populating the lower Calaveras River.

- ***Are there adequate flows in the lower Calaveras River to support salmon and steelhead?*** Year-round flows occur in the lower Calaveras River below New Hogan Dam from reservoir water supply releases. Bank-full flows in excess of 1000 cfs occur in most wet years from a combination of local runoff and spill from New Hogan when the reservoir reaches its winter flood capacity of 152 TAF. However during dry years, winter releases from New Hogan fall to 10-20 cfs for extended periods, such as in March and April in 2002 (see Figure 3). Historically, winter releases from New Hogan have reached near zero (most recently in the winters of 1994 and 1995). Trout production and survival in these years was very poor. The resident trout population expanded during the wet years from 1996 to 1999, and appears to have been sustained in the last two dry years by minimum flows in the 10-20 cfs range. Snorkel surveys in year 2002 by the Fishery Foundation indicate a healthy wild resident trout population persists with adequate spawning and young recruitment to the population. Instream flow studies of salmonid habitat suitability are planned by AFRP for year 2004.

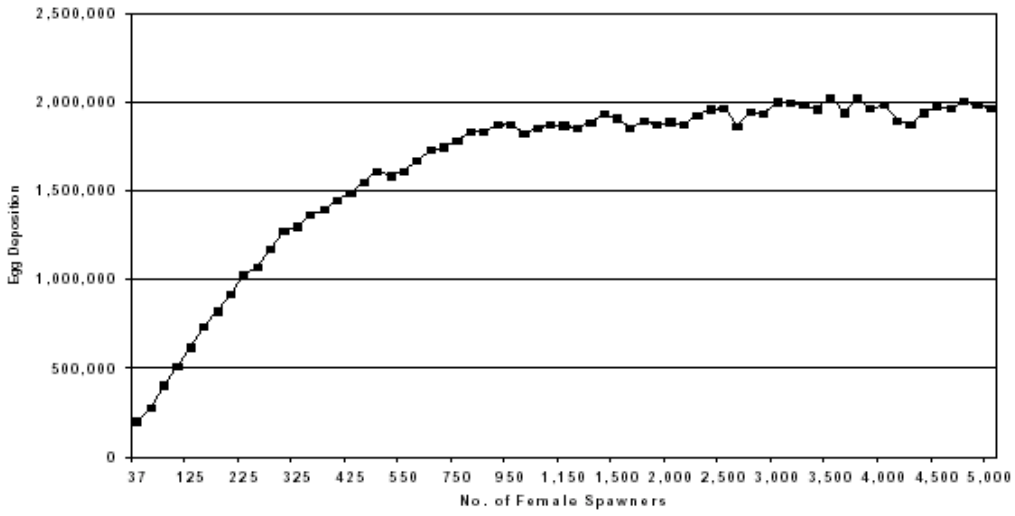

Figure 7. Number of viable eggs potentially deposited at the end of the spawning season in the 1.5-mile reach of the Calaveras River downstream of New Hogan Dam. (Source: Stillwater Sciences 2000)

- ***Are there significant unscreened diversions that impact young salmon and other fishes?*** There are a approximately 30 unscreened water diversions on the river that could entrain young salmonids. The largest, the SEWD diversion at Bellota Weir, is unscreened and entrains young salmonids throughout much of the year. Other unscreened diversions include portable pumps that pump water from the river during the irrigation season from spring through early fall. The potential effect of these diversions is presently limited because few salmon and steelhead spawn in the river above Bellota. If this were to change through improved passage, then the effects of unscreened diversions could be substantial. SEWD is presently conducting an evaluation of diversion effects and potential screening solutions under a grant from CALFED.

- ***Is the water temperature of the lower Calaveras River excessive for natural rearing of juvenile salmon and other native fishes, because of inadequate streamflow and loss of riparian shade trees and shrubs?***
  Water temperature in the lower Calaveras increases slightly in the spring as streamflow declines and ambient air temperatures reach high levels typical of the Central Valley. However, for the most part with bottom releases from New Hogan Dam, water temperatures remain within the optimal 12-16ºC range for juvenile salmonids (Figure 8). Only in years when New Hogan storage falls below 85 TAF does water temperatures rise above 18ºC consistently (USFWS 1993).

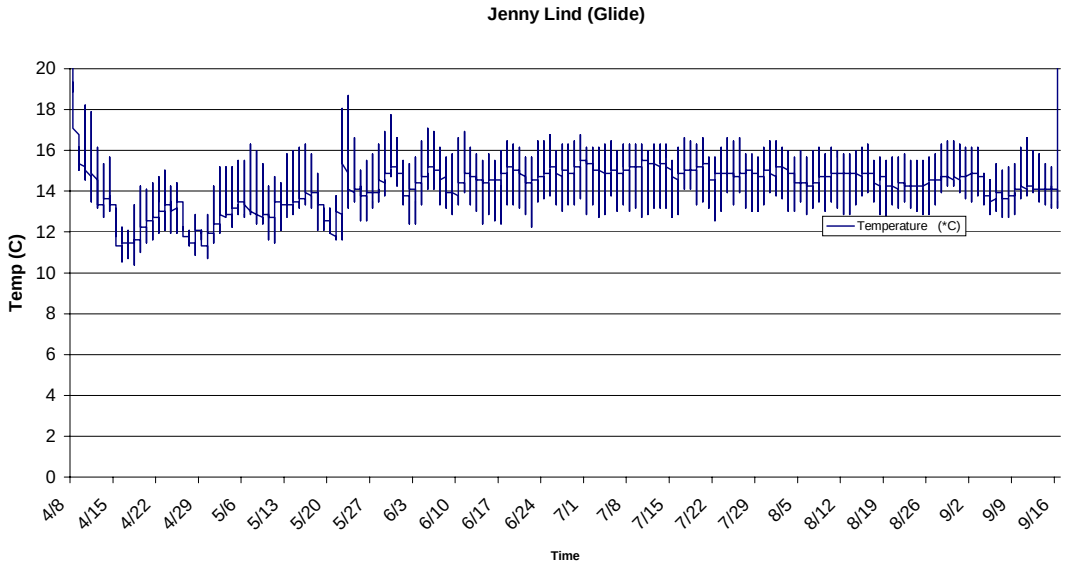

Figure 8. Water temperatures at Jenny Lind in spring and summer of 2002.

Proposed Restoration Actions

We have developed the following recommended recovery plan for the Calaveras River salmon and steelhead populations based on general and specific recommendations of the AFRP,

CALFED, and Task Force. The Plan is for a stepwise program that is consistent with the CALFED Program objective of adaptive management. The major steps are proposed in logical sequence to maximize the cost effectiveness of the recovery program. The plan is based on existing knowledge of the river ecosystem, especially information from studies during the past two years. The plan focuses on a stepwise elimination of limiting factors to salmon and steelhead production in the river. The steps are sequential, however, there is room for overlap and later steps can be initiated before prior steps are fully completed. Priority 1 actions are important to implement immediately given the present information available and should be implemented first. If these are successful, then Priority 2 and 3 actions may be considered with additional information provided by ongoing studies. Priority 4 and 5 actions should be considered later after early priority actions are complete and information is available from further monitoring and research programs.

Priority 1: Restore Adult Salmonid Passage

The initial step in restoring salmon and steelhead populations in the lower Calaveras River is to provide passage for adults from tidewater to spawning habitats in the upper portion of the lower river above Bellota Weir. Presently this is the primary limiting factor to anadromous salmonid production in the Calaveras River. There is virtually no passage in the Old River Channel and limited passage in Mormon Slough. Mormon Slough passage is limited by low flows, and passage problems at flashboard weirs and the Bellota Weir.

Action 1-1. Construct a permanent fish ladder at Bellota Weir at the head of Mormon Slough.

The Fishery Foundation and the AFRP working with SEWD are attempting to obtain funding from the USFWS National Fish Passage Program and CALFED to build a permanent fish ladder at Bellota Weir. Because Mormon Slough is the major flood flow conveyance channel in the USACE flood control system of the lower Calaveras River providing passage at the weir will be necessary regardless of future fish passage configurations of the lower river. The schedule for this task is for construction in the summer of 2003.

Action 1-2. Provide 20 cfs flow below Mormon Slough to tide water during November.

To allow passage of fall-run Chinook salmon to Bellota Weir during the annual fall run, 20 cfs of flow would be provided between Bellota Weir and tidewater in Mormon Slough. Approximately 2000 acre-feet of water would be required from New Hogan Reservoir to provide these flows. The Fishery Foundation and the AFRP are seeking the necessary water from several sources:

- The CALFED Environmental Water Account (EWA) could purchase the water needed. The EWA has set a goal of acquiring at least 190,000 acre-feet of water each year through purchases. EWA expects to obtain another 190,000 acre-feet of water on average each year through additional pumping at times safe for fish. The EWA could also simply borrow the water from storage in New Hogan Reservoir with the hope that the reservoir would refill to its maximum winter level of 152 TAF. During November 2002 no flows occurred in the lower Calaveras. New Hogan Reservoir contained over 120 TAF in November. The 2 TAF necessary would have been a small amount of the available storage and the chances of recovering that amount during the winter are very good. Only during the drought of 1987-1992 did the reservoir fail to refill during the winter (Figure 9). Only in such an event would

the EWA be required to make up the water[2]. In such case the EWA has several available sources to make up the water including direct purchase or trading water available from its account in New Melones Reservoir (Stanislaus River).

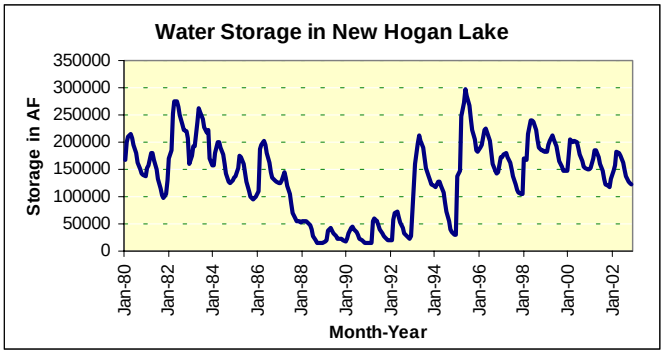

Figure 9. Water storage in New Hogan Lake 1980-2002.

- A second source of 2 TAF of water is available via the CVPIA b(2) account by simply allocating about 2 percent of the reservoir water available to the account from New Melones Reservoir. The New Melones water can be sent directly to the SEWD water treatment plant via existing conveyance channels at any time to make up for SEWD 2 TAF of storage in New Hogan Reservoir.
- A third source could be direct purchase of the water from New Hogan or New Melones using the CVPIA b(3) account. Again, New Melones water would be exchanged for New Hogan water that would normally be diverted or stored by SEWD.

Action 1-3. Improve fish passage at flashboard weirs and road crossings in the river downstream of Bellota Weir in Mormon Slough and the Diverting Canal

With 20 cfs of flow in the fall to Mormon Slough, passage at several flashboard weirs and road crossings would be at least a partial hindrance to upstream passage in the Diverting Canal and Mormon Slough (Figures 10 and 11). Passage at these individual weirs and crossings should be improved to focusing flows over the most passable portion of the weirs (as at road crossing in Figure 11). The DWR-FPP is conducting a study of the hydraulics at each of these weirs and road crossings to determine the most economically efficient means of improving passage. Based on their initial studies, improvement could be made as early as summer 2003.

Action 1-4. Improve adult salmonid upstream passage in the Old River Channel.

In high flow periods of the winter and spring, flows in the Old River Channel may be sufficient to attract winter-run salmon or steelhead up into the Old River Channel where they would be stranded and incapable of passing upstream of the Bellota control weir (see Figure 5). There are two solutions to this problem that are being studied by the DWR-FPP study: improving passage at individual flashboard weirs in the Old Channel and constructing a permanent fish ladder at the weir at the head of the channel at Bellota. Having two possible routes of passage to the upper reach above Bellota (the Old Channel or Mormon Slough) offers two possible routes for low flow season passage. The DWR-FPP study will determine which route is the most effective at low winter flows. In the short-term, improvements in passage in the Old Channel can be made at selected facilities. Another short-term option is to block off the mouth of the Old Channel to ensure no salmon or steelhead ascent the channel.

Action 1-5. Improve winter flows in the lower river channels.

[2] The EWA may be able to borrow over a multiyear period such that repayment would only be required when the water borrowed would be needed in the future.

In dry years flows in the lower river system in Mormon Slough and the Diverting Canal are too low to provide adequate upstream passage of winter-run salmon and steelhead. Flows in either Mormon Slough or the Old River Channel could be supplemented to provide 20 cfs for fish passage during a one-month period from mid January to mid March when most winter-run salmon and steelhead would be expected to migrate into the river. In dry years the cost of this water could amount to 2 TAF. Sources for this water would be as in Action 1-2. The frequency of this need would be considerably less than the flow needs of Action 1-2, because winter flows are generally greater than fall flows.

Figure 10. Flashboard weir in Diverting Canal near Hwy 99. Passage is a problem at this and similar weirs at low flows (< 20 cfs), but are generally passable at flows above 20 cfs as in this photo. The weirs hold water during the irrigation season to allow diversions and groundwater recharge.

Figure 11. Salmonid passage has been enhanced at the road crossing in the Diverting Canal by channeling low flow through one small area rather than over the entire base of the structure.

Priority 2: Restore Salmonid Downstream Passage

If Priority 1 actions are successful, then actions should be considered to improve smolt salmonid emigration from the river. Under present conditions downstream passage of juvenile salmon and juvenile and adult steelhead could be problematic in dry years when streamflow below Bellota Weir is near zero. In wet years such as 1995 through 2000 there were short periods when high flows provided optimal conditions for young salmonids to emigrate from the river (see Figure 3). In contrast in 1994, 2001, and 2002 flows were inadequate for passage being either zero or very low for most of the winter and spring. With some flow over Bellota Weir young fish pass downstream into Mormon Slough where flows may fall to zero. When the irrigation season begins in April, flow releases into the two channels below Bellota may carry young salmonids that become stranded downstream after flashboards are installed at weirs and water diversions begin. Stranded fish appear to survive in the Old River Channel until fall only to succumb to stranding when irrigation flows cease. In Mormon Slough over-summer survival appears to be more of a problem than in the Old River channel because of warmer water temperatures and possibly more predation by birds and fish. In the past ten years, spring flows were only adequate for downstream passage in 1998 (see Figure 3).

Action 2-1. Improve flows for passage in fall and winter for downstream migrating salmon and steelhead smolts.

The fall flow pulse described in Action 1-2 and the winter pulse in Action 1-5 in dry years would provide opportunities that would otherwise not exist for young and yearling salmon and steelhead to pass through the lower river to the Delta. Young salmon that over-summer in the Calaveras between New Hogan Dam and the Bellota Weir may migrate if given an opportunity in November or in mid winter. Young and yearling steelhead may migrate in November or winter. Post-spawn adult steelhead may choose to return to the ocean if provided an opportunity in winter.

Action 2-2. Improve flows for passage in spring for downstream migrating salmon and steelhead.

At the beginning of spring in dry years the temporary fish ladders are removed and flashboards installed in weirs as irrigation is supported by releases from New Hogan Dam. The lower river channels are usually dry as all the water is either diverted or seeps into the groundwater table. Increased dams releases began on March 31, 2001 and April 11, 2002 (see Figure 3). Young salmon and young and yearling steelhead trout may be induced to emigrate with these higher flows, as the early spring is an important migrating period for both species. Young trout were observed passing through the Bellota Weir flashboard outlets in April 2002 when flows ranged from 30-80 cfs (Figure 12). As no flow reached the lower river due to diversions and seepage to groundwater, these trout were unable to complete their

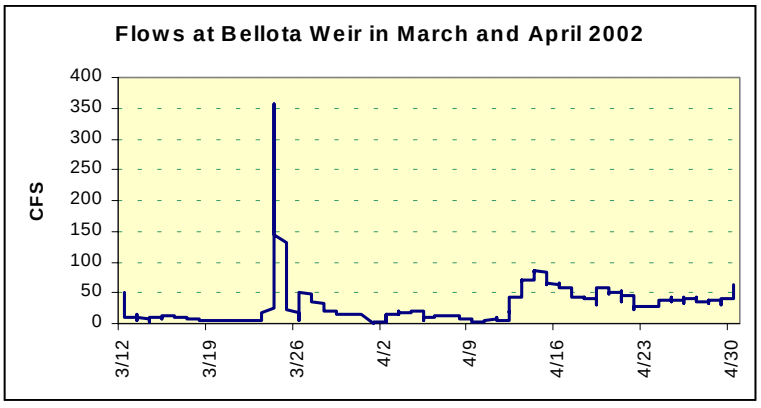

Figure 12. Flows at Bellota Weir in March-April 2002.

emigration and likely died by late spring when water temperatures reach lethal levels. A similar situation occurs in the Old River Channel; however, conditions in that channel appear more conducive to over-summer survival as it is narrower with a more extensive riparian canopy that provides shade.

Under these conditions providing a one-month allotment of 20 cfs flow through the lower reach to tidewater would provide for passage in spring (April-May). Again, the amount of water required and sources would be similar to that in Action 1-2.

Priority 3: Restore Spawning and Rearing Habitat

The third step after providing adequate passage for salmon and steelhead is to improve spawning and rearing habitat to maximize production of young salmon and steelhead. Existing spawning habitat appears adequate to sustain a much larger run of salmon and steelhead (if passage is provided above Bellota Weir). Rearing habitat for salmon and steelhead remains problematic. Limiting factors to salmon and steelhead production in the Cosumnes River likely include habitat factors such as predation and competition from non-native fishes, low streamflows, high water temperatures, degraded stream channels, high suspended sediment, and poor water quality. The following actions are for restoring rearing habitat of juvenile salmonids.

Action 3-1. Improve extreme low non-irrigation season releases from New Hogan Dam
Releases from New Hogan Dam in the winter over the past decade have fallen to 0-5 cfs and resulted in fish kills. Flows during the dry winters of 2001 and 2002 were maintained at 12 to 15 cfs and no fish kills were observed. Maintaining flows above 10 cfs would require approximately 1000 acre-feet of water released from storage based upon flow records over the past decade. Although this is a relatively small amount of water, during drought periods runoff into the watershed has been as low as only 12 TAF per year (1961). During the extreme drought of 1987-1992, inflow (Figure 13) and water storage (see Figure 9) were likely inadequate to sustain both water users and these proposed releases for fish. Furthermore, winter releases from New Hogan Lake could increase the chance that the reservoir would fall below the 85 TAF level needed to sustain summer cool water temperatures in the river.

As in Action 1-2, the amount of water needed and sources would have to be developed for these fish habitat flow releases. The AFRP plans to conduct instream flow studies to determine minimum flows for fish in the lower Calaveras River in 2004. Consultation has occurred between the Corps of Engineers and the National Marine Fisheries Service (NMFS) over the stranding of steelhead below New Hogan Dam. A biological opinion has been completed. The SEWD is participating with NMFS in an informal consultation on the operations of New Hogan Dam.

Action 3-2. Reduce the population of non-native and native predatory fishes.
A serious obstacle to successful rearing and downstream migration of juvenile salmon is the presence of predatory fishes in the lower Calaveras River. Non-native black bass and other centrarchids, as well as native pikeminnow are found in the lower river above and below Bellota Weir, and in Cosgrove Creek, the major tributary below New Hogan Dam. The populations of these fishes can be controlled indirectly through habitat improvements and directly by removal

(e.g., by seining). It may be possible to control populations of non-natives in Cosgrove Creek by rotenone treatments during the summer when flows are low and trout do not live in that stream because of high water temperatures. The need for treatment of non-natives and predators in each reach of the river will have to be determined through further study.

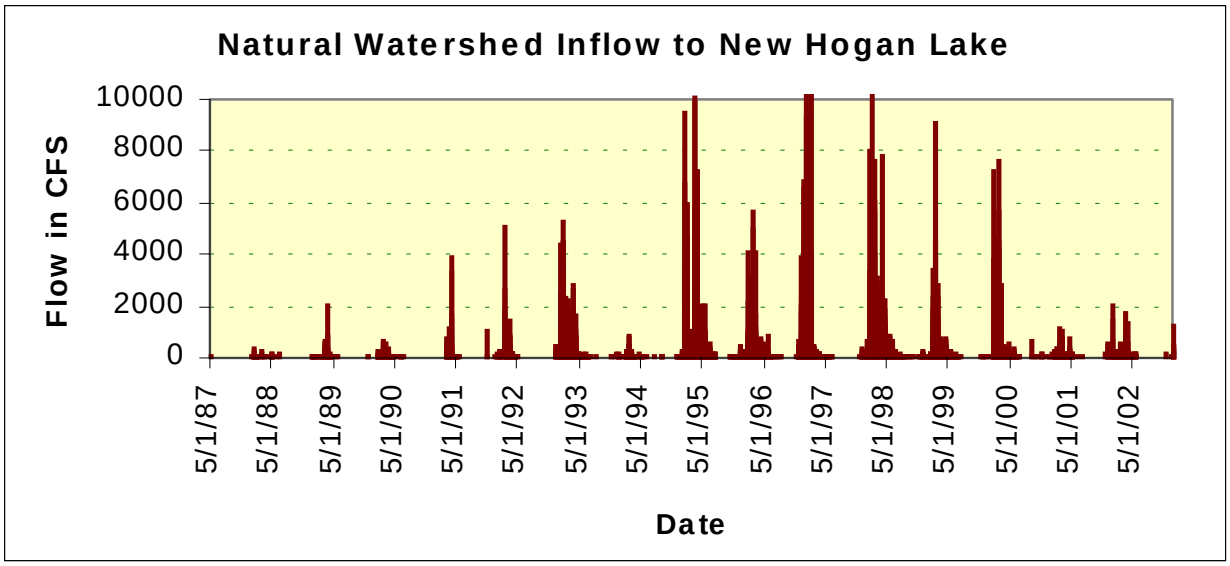

Figure 13. Natural watershed inflow to New Hogan Lake from the upper watershed of the Calaveras River from May 1987 to December 2002.

Action 3-3. Block non-native predator and competing fish from entering lower river.
To ensure that non-natives do not reinvade the lower Calaveras River from Delta tidewaters it may be necessary to block their upstream migration at the head of tidewater with some type of weir structure. Seasonal anadromous migrants such as striped bass, pikeminnow, Sacramento sucker, tule perch, black bass, crappie, and American shad would be blocked. Similar "predator" weirs have been constructed by CDFG on Hat Creek and the North Fork of the Feather River.

Action 3-4. Develop a plan to improve streamflow throughout the year.
Streamflow is a major limiting factor in the lower Calaveras River especially in dry years, when stream flows may fall to near zero in the spawning and rearing reach between New Hogan Dam and Bellota Weir. Existing trans-basin and in-basin water diversions, and groundwater overdrafts limit streamflow in the river. Reducing diversions and groundwater loss through water purchases or replacement (e.g., with New Melones Water) may improve streamflow in the river particularly during key periods of the year. DFG (1993) stated: *"With appropriately timed flows and improved fish passage, runs of winter-run and fall-run chinook salmon could be maintained on a consistent basis."* The CCWD and SEWD are conducting a watershed study funded by a State Proposition 204 grant to study water supply options for the watershed[3].

[3] The Calaveras River Watershed Management Plan Phase II Baseline Water Quality Monitoring is being conducted by CCWD. Data will be collected to develop a water quality baseline for the Calaveras River Watershed focusing primarily on the upper watershed.

Estimates of the total amount of water needed to improve streamflow range from 84 TAF (DFG 1990) to a minimum of 5 TAF as prescribed in non-drought years in this plan.

Action 3-5. Improve stream channel habitat in degraded reaches of the Calaveras River

Two reaches that have been identified with channel degradation are the section immediately below New Hogan Dam and the sections immediately above and below Bellota. The section below New Hogan Dam suffers from lack of gravel recruitment and channel incising, and vegetation encroachment on gravel bars (Figure 13). Gravel introductions are one possible course of action that would increase the amount and quality of the spawning habitat. Upstream of Bellota where the channel is degraded by gravel mining, the channel can be restored by direct reconstruction.

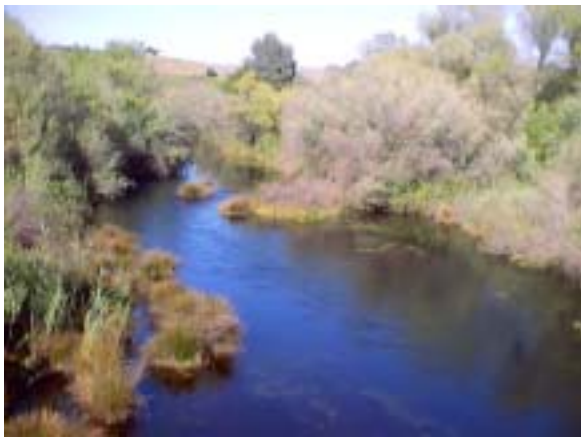

Figure 13. Calaveras River below New Hogan Dam with vegetation encroachment.

Action 3-6. Screen water diversions.

Water diversions upstream from Bellota Weir could be screened to reduce the losses of young salmon and steelhead into water supply systems. Young trout and salmon are susceptible to being entrained into these diversions during the spring through summer irrigation season and in the fall and winter municipal water supply diversions. The SEWD is studying options for screening diversions with a grant from the CALFED program[4].

Action 3-7. Remove weirs that block passage and alter habitat.

The lower river below Bellota has many control structures including the Bellota Weir that block fish passage and alter the channel gradient (Figures 14 and 15). Some of these structures could be removed to improve passage and stream habitat. For example, the Bellota Weir alters the channel and stream habitat for nearly one mile upstream. Its removal could restore spawning and rearing habitat for salmon both upstream and downstream. Other means of providing surface water and recharging groundwater in the area would have to be developed to reduce reliance on the river for water and conveyance.

Figure 14. Road crossing in Mormon Slough.

[4] The SEWD is taking the lead in cooperation with CCWD to investigate fish entrainment and mitigation measures on the upper Calaveras River (above Bellota). The CALFED funding will be handled through the National Fish & Wildlife Foundation. The District has contracted with CHM2Hill in August 2002 for a three-year study. There will be no construction of facilities under this contract.

Figure 15. Flashboard weir in Mormon Slough during irrigation season (mid March to mid October). During non-irrigation season flashboards are removed.

Priority 4: Restore Winter-Spring Chinook Salmon

A possible fourth step to consider for the Calaveras River is restoration of the winter-spring run Chinook salmon that once migrated into the lower river by the hundreds and perhaps thousands in some years. The USFWS (1993) believed that restoring the winter-run Chinook salmon was "*the most feasible option for the Calaveras River"*. With adequate passage and improvements to spawning and rearing habitat, winter-spring run Chinook salmon offer more potential for successful introduction than fall-run Chinook salmon. Adult winter-spring run would migrate up the river during the winter and early spring when flows are more dependable than in the fall. Spawning would occur in the late spring and summer irrigation season when flows are greater and provide for more spawning and rearing habitat. Cold water temperatures below New Hogan Dam (at least during non-drought year conditions as in the last decade) are ideal for summer spawning Chinook salmon (Figure 16). Existing spawning habitat appears adequate with some improvements (e.g., gravel introductions) to sustain a run of several thousand winter-spring run salmon. During the initial introduction and population expansion period, it may be necessary to supplement natural production with artificial propagation.

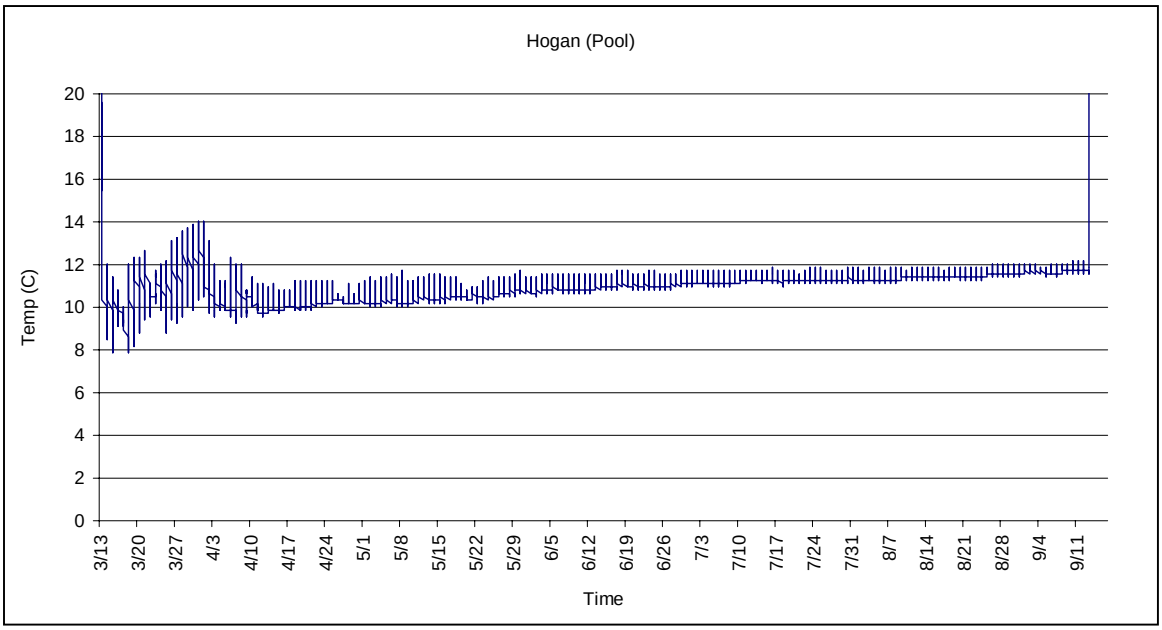

Figure 16. Water temperatures below New Hogan Dam in the spring and summer of 2002.

Priority 5: Sustaining Salmon and Steelhead Populations through extended Droughts

To sustain salmon and steelhead populations through extended droughts such as during the period 1987-1992 more extreme actions will be required. Each of these actions have been either undertaken or considered in the past (DFG 1982; USACE 1981).

Action 5-1. Trap and haul adult salmon and steelhead to the spawning reach above Bellota

In the event adequate passage flows cannot be maintained in the fall and winter for upstream migrating salmon and steelhead during extended droughts, adult migrants may be captured at the upper end of tidewater and hauled above Bellota Weir. Fish collections and hauling of salmon were conducted by DFG from 1972 to 1976.

Action 5-2. Trap and haul juvenile salmon and adult and juvenile steelhead emigrating from the River at Bellota

In the event adequate passage flows cannot be maintained below Bellota for out-migrating juvenile salmon and adult and juvenile steelhead, they could be trapped at Bellota and trucked to tidewater to facilitate their migration.

Action 5-3. Artificial Propagation of Salmon and Steelhead

If adequate flows or water temperatures do not occur in the spawning and rearing reaches below New Hogan Dam, wild adult salmon and steelhead that enter the lower Calaveras River could be captured, spawned, and eggs and young reared in hatchery facilities for stocking in the lower Calaveras River or Delta.

Consistency with CALFED Program

The CALFED program has several requirements for ecosystem restoration programs:

- ***Targeted Research*** *may be necessary to resolve critical issues about ecosystem structure and function that preclude us from even defining problems sufficiently for pilot restoration actions to go forward.* The proposed restoration program is based on targeted research on anadromous fish passage and juvenile emigration that has been conducted by SEWD, DWR-FPP, and the Fishery Foundation over the past several years. Surveys have indicated that salmon and steelhead have a difficult time when ascending the Calaveras River because of migration barriers. Salmon have spawned in marginal habitat in the lower river. These studies indicate that poor passage and habitat conditions likely limit salmonid production in the Calaveras River.
- ***Pilot or Demonstration Projects*** *can help to determine the practicality or effectiveness of restoration actions, allowing resource managers to evaluate alternative actions or build confidence in the ability of a particular action to achieve an objective.* The actions proposed are recommended in steps to ensure progress is made and demonstrated before moving on to later steps. The proposed fish passage and flow enhancements would be considered demonstration projects to determine if salmon and steelhead production could be increased on the Calaveras River.
- ***Full-scale Implementation*** *can begin for those restoration actions that have demonstrated success at the pilot project scale, and for which there is reasonable confidence that the objective will be achieved.* The proposed restoration program calls for several full-scale implementation actions after an initial set of actions is completed. Other proposed projects are only concepts at this time, and need further evaluation and study.

The following are a list of CALFED Goals for Ecosystem Restoration along with a discussion of how these goals are addressed by the proposed Restoration Program.

Goal 1: At-Risk Species - Achieve recovery of at-risk native species dependent on the Delta and Suisun Bay as the first step toward establishing large, self-sustaining populations of these species; support similar recovery of at-risk native species in San Francisco Bay and the watershed above the estuary; and minimize the need for future endangered species listings by reversing downward population trends of native species that are not listed.
The proposed restoration program focuses on Chinook salmon and steelhead. Fall run Chinook have been proposed for listing because of declining wild populations in Central Valley rivers. The fall run Chinook population in the Calaveras had been wiped out in the drought of the late 1980's and early 1990's. In recent years the run has been very low with only a few pairs spawning in the river below the Bellota Weir. Steelhead are listed as a threatened species and have been considered extinct from the Calaveras River. Restoring steelhead to the Calaveras would help widen their range in the Central Valley.

Goal 2: Ecosystem Processes and Biotic Communities - Rehabilitate natural processes in the Bay-Delta system to support, with minimal ongoing human intervention, natural aquatic and associated terrestrial biotic communities and habitats, in ways that favor native members of those communities. The proposed restoration program has actions that will restore natural stream flows, stream channel configuration, and riverine habitat.

Goal 3: Harvestable Species - Maintain and/or enhance populations of selected species for sustainable commercial and recreational harvest, consistent with the other ERP Strategic Goals. Chinook salmon presently number only a few dozen in the Calaveras River run, while their potential is several thousand or more. Recovery of their population will enhance commercial and recreational harvest in the Bay-Delta and Pacific Ocean. Steelhead restoration will enhance recreational fishing opportunities in the Calaveras River that presently are minimal.

Goal 4: Habitats - Protect and/or restore functional habitat types in the Bay-Delta estuary and its watershed for ecological and public values such as supporting species and biotic communities, ecological processes, recreation, scientific research and aesthetics. The proposed restoration program will restore function habitat in the Bay-Delta watershed to support salmon and steelhead, as well as other native species.

Goal 5: Non-native Invasive Species - Prevent the establishment of additional non-native species and reduce the negative biological and economic impacts of established non-native species in the Bay-Delta estuary and its watershed. The proposed program seeks to reduce the numbers of non-native invasive species. Non-natives dominate the fish fauna of Cosgrove Creek.

Goal 6: Sediment and Water Quality - Improve and/or maintain water and sediment quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta watershed and eliminate, to the extent possible, toxic impacts to aquatic organisms, wildlife, and people. The proposed restoration program would improve water temperature, reduce suspended sediments, and more fully support a healthy diverse native fish community and ecosystem in the Calaveras River.

Conclusions

Restoration of Chinook salmon and steelhead runs on the Calaveras River appears feasible if passage and minimum streamflows and New Hogan Reservoir storage can be maintained. The difficulty will lie in maintaining the populations during a drought like that of the 1987-1992 period when there was insufficient flow to water the stream and keep water temperatures at safe levels through the summer. The initial steps toward restoration proposed in this plan would help sustain salmon and steelhead populations in non-drought periods and build populations to targeted levels. Populations may decline sharply during drought periods as they did historically in the intermittent streams of the Central Valley, only to rebuild again after droughts from populations sustained in other rivers. Supplemental propagation and trap and haul actions would help to sustain the Calaveras populations of salmon and steelhead through droughts.

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